

## *Grevillea laurifolia* subsp. *caleyana* Olde (Proteaceae: Grevilleoideae: Hakeinae), a new subspecies from the Blue Mountains of New South Wales, Australia

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### Abstract

A morphological study of living plants and herbarium specimens has here resulted in the formal recognition of two parapatric subspecies in *Grevillea laurifolia* Sieber ex Spreng., the autonymic subsp. *laurifolia*, and the novel subsp. *caleyana* P.M.Olde. Some critical phenetic characters show a strong morphological approach in specimens collected around Wentworth Falls which suggests that this area is a narrow geographic zone where the two subspecies intergrade. Notwithstanding the morphological approach all specimens examined were classifiable in one or other subspecies on the basis of their pistil lengths. A key to the subspecies of *Grevillea laurifolia*, descriptions of all taxa discussed, notes on conservation status and distributional information are provided.

### Introduction

*Grevillea laurifolia* was first introduced to botanical science through a collection made by George Caley, who discovered and collected it in November 1804 on or near Mount Banks, in the Blue Mountains of New South Wales. According to Vallance (2001, p. 566) the specimens of this collection were seen by Robert Brown on 16 December 1804, soon after Caley returned from his exploration. Habituated to list-making, Brown itemised Caley's collections in his diary under the heading 'Plants seen in Mr Caley's herbarium collected in his excursions to the Carmarthen Hills – Novr 1804'. Recorded among them was 'Embothrium procumbens' from 'Mount Banks', the genus *Embothrium* used by both Caley and Brown to include all *Grevillea* and related species while in Australia, following Smith (1794). Brown was not given a specimen and did not describe this species. Aware of Caley's intention to write up his own discoveries, he wrote instead (1810a, p. 226) that Caley's 'numerous discoveries will, it is hoped, be soon given to the public, either by himself, or in such a manner as to obtain for him that reputation among botanists to which he is well entitled.'

Subsequent collections by Allan Cunningham (1817) and Charles Gaudichaud-Beaupré (1819) also did not result in species description. It was a collection in 1823 made by the industrious Franz Sieber (1789–1844) that resulted in the naming of *Grevillea laurifolia* by Kurt Sprengel (1766–1833) in 1827. This publication completely overturned any botanical ambition Caley may have entertained for his discovery, though by 1827 he had probably abandoned it himself.

Shortly after Caley's death in 1829, Robert Brown (1830, p. 17) cited Caley's collection of *G. laurifolia* in his treatment of that species. Although Brown often drew fine botanical distinctions, he made no mention that the taxon represented by Caley's specimens might be different to that collected by Sieber, a specimen of which

he had examined in Lambert's herbarium. Subsequent authors including Meisner (1856) and Bentham (1870) followed Brown.

Michel Gandoger (1919, p. 231) first described variation in *Grevillea laurifolia* by recognising two species, *Grevillea amplifolia* Gand. and *G. cordigera* Gand. He treated *G. laurifolia* as a *grex* (apparently using this term to mean a species complex, rather than its usual modern meaning and exclusive formal use as the assemblage of offspring of an artificial hybrid) and within which his two species were delimited on the basis of leaf characters including width, shape and base. *Grevillea amplifolia* was diagnosed on the basis of its leaves being oblong and the leaf base attenuate. Leaves ovate and leaf base cordate defined his *G. cordigera*, a name based on a single specimen without precise locality, collected by Charles Walter (?1831–1907) in 1902. The flowers have not reached anthesis on the type specimen of *G. cordigera* at LY, but the foliage is similar to that collected by Caley, though it could conceivably represent an intergrade. Application of the name *Grevillea cordigera* Gand. is therefore uncertain with respect to the subspecies recognised here, although its leaves indicate that it is most likely to be a synonym of *Grevillea laurifolia* subsp. *caleyana*.

Musson and Fletcher (1927) and G. McLuckie (1930) demonstrated that *G. gaudichaudii* R. Br. ex Gaudich. was a natural hybrid and implicated *G. laurifolia* and *G. acanthifolia* subsp. *acanthifolia* in its parentage. *Grevillea gaudichaudii* has been frequently recorded in disturbed situations from the time of its first collection in 1819 to the present, where both parents occur sympatrically. The two species are inter-fertile and hybridism is apparently bird-vectored.

D.J. McGillivray and R.O. Makinson (1993, p. 425) treated both Gandoger 'species' as synonyms of *G. laurifolia* without comment but they also (1993, p. 58) informally recognised a 'smaller-flowered form', noting that 'plants in the Wentworth Falls to Valley Heights area, in the lower elevations of the species' range are noticeably smaller-flowered (pistils  $\leq$  c. 15 mm) with more compact and semicylindrical inflorescences, and (at least in some populations) with very deeply purplish red flowers.' Although it was not stated, there is an implication either that further study was required or that high levels of morphological overlap were found that resulted in an inability to recognise formal infraspecific taxa. Alternatively, a species concept, discussed by Olde and Marriott (1993b), that required levels of morphological discontinuity applicable to the recognition of species, was being employed in the recognition of potential subspecies. In the absence of the necessary study, subsequent authors (Olde and Marriott 1995, Makinson 2000, Makinson 2002) have followed this treatment to the present time.

The impact of a chance comparison of a widely cultivated plant of *G. laurifolia* and a specimen of the smaller-flowered form led the author to this more detailed investigation of the variation in *G. laurifolia*. This study was framed to investigate whether formal recognition of the 'smaller-flowered form' within the geographic boundary observed by McGillivray and Makinson, or some other boundary, was justified. To this end, 24 characters were measured and examined for their ability to link morphology with distribution.

## Morphology

Morphological terminology follows that consistently applied in descriptions of *Grevillea* by Robert Brown (1810a, 1810b, 1830) and modifications or additions made by Meisner (1856), Bentham (1870), Johnson and Briggs (1963, 1975), Briggs and Johnson (1977), McGillivray and Makinson (1993), Olde and Marriott (1993a, 1993b, 1994a, 1994b, 2009), Makinson (2000) and Stajsic and Molyneux (2005). Species and subspecies concepts outlined by Olde and Marriott (1993b), Hart and Henwood (1996), Downing et al. (2004) and De Quieroz (2007) formed the basis of the proposed classification. Subspecies would be recognised if the populations could be defined geographically and could be classified with a high degree of reliability (over 90%). Some morphological overlap could be accepted as evidence for infraspecific gene flow but would have to be restricted to a narrow geographic zone of intergradation and not found randomly.

The term 'common bract' here replaces the term 'floral bract' to maintain usage consistent with descriptions in the Proteaceae generally. As Johnson and Briggs (1963) and Douglas and Tucker (1996) point out, floral bracts in *Grevillea* are suppressed and only the common bract subtending the flower pair remains.

The term 'peduncular bract' was used by McGillivray and Makinson (1993, pp. 3, 8) to describe bracts that sometimes occur sporadically along the peduncle, extending sometimes to its base. They are often larger than involucral and common bracts and sometimes longer persistent. They have a close relationship with bractiform leaves differing from them only in that they subtend remote flower pairs rather than vegetative buds.

Stylar angularity here alludes to the coursing of the style after anthesis, not to its cross-sectional shape. In *G. laurifolia*, the style was observed to either loop smoothly and arcuately or to change direction by a process of angular infraction. In the latter, the ultimate infraction or 'hooking' is a subterminal geniculation above

a straight stylar segment. To some degree, the character is fluid in that smoothing out of the angles occurs ontogenetically. At anthesis, both subspecies exhibit stylar angularity just below the style-end. In addition, although stylar angularity is a strong field character it may not always be retained on dried material.

The ‘rachis extension’ alludes to the [sometimes] abortive, vegetative terminus of the blastotelic, anauxotelic floral rachis in *Grevillea*, as defined by Briggs and Johnson (1977, p. 176). The extension may sometimes be obscured by reduction, but when present, as in *G. laurifolia*, has been observed to vary in length. Its value as a character is unknown but in studies of the *G. alpina* complex currently in train it has proved critically diagnostic in the recognition of some taxa.

A leaf lobe is usually defined simply as part of a leaf enclosed by embayed or angular incisions in the margin. However, it is more strictly interpreted here as formed around a lateral or secondary vein that terminates at the margin in a short excurrent spine or mucro. Marginal teeth are short lobes formed from a higher order lateral vein or vein subsidiary to the intramarginal vein, but with a similar terminus. In a situation where both lobes and teeth are present, Crisp and Weston (1993, p. 56) have suggested that ‘the relative prominence of the vein leading to the lobe or tooth’ be used to differentiate them. Leaf-margin sinuation or crenulation differs in its lack of venation and is not therefore treated as a form of division.

## Method

Ninety vouchered specimens were selected from the whole distribution of *G. laurifolia* located in several herbaria, including AD, CANB, G, LY, MEL, NSW, NY, P and PERTH but mainly NSW (herbarium codes follow Holmgren et al. 1990). Nine foliar, eight confluence and seven floral characters were measured and assessed for their ability to link distribution with morphology. Supplementary specimens were also collected in the 2014 flowering season from the whole range and examined *in vivo*, before being pressed, dried and lodged at NSW.

## Results

Inspection of the data showed that variation in *G. laurifolia* is clinal, roughly along an east-west axis. Morphological characters with small discontinuities and some with low levels of overlap were identified in the study. Two characters in particular, pistil length and the length to width ratio of a range (up to 10) of leaves present on a specimen, conclusively supported the formal recognition of two geographically parapatric taxa, here treated as subspecies, through their ability to, each separately and in combination, link phenotypes with distribution. Pistil length alone was able to distinguish the proposed taxa 100% of the time on fertile specimens while leaf ratios were able to distinguish fertile and infertile specimens more than 95% of the time. Several other characters which supported the distinction in more than 90% of cases are noted in the key to taxa. All characters are treated in the subspecific descriptions.

The autonymic subspecies *laurifolia*, consonant with Gandoger’s *Grevillea amplifolia* and the ‘smaller-flowered form’ *sensu* McGillivray and Makinson, is distributed exclusively in the lower and middle altitudes of the Blue Mountains below 875 m to the east of Wentworth Falls. Specimens with dense, semi-cylindrical confluences, maroon-black-red-coloured flowers, perianths 5–6 mm long, pistils 9.5–14(–14.5) mm long with angular styles and leaves with a length to width ratio (using all leaves on a specimen) >2.2:1 were found in populations distributed east of Wentworth Falls 100% of the time. The remaining specimens distributed to the west, north and south of Wentworth Falls are treated as part of a novel, unrecognised taxon, here described as *G. laurifolia* subsp. *caleyana*, for which the countervailing morphological features were consistently found: moderately condensed, strongly secund confluences, bright red-coloured flowers (principally the styles and perianth adaxial surface), perianth 7–9 mm long, pistils 17–28 mm long with arcuately looped styles and leaves with a combined length to width ratio (using all leaves on a specimen) <2.2:1.

In this examination, Wentworth Falls emerged as a geographic boundary between the subspecies and, to some extent, it and its immediate vicinity as a zone of apparent morphological intergradation. Of the 11 specimens seen or examined from Wentworth Falls, five, *Blakely* (NSW92283), *Deane* (NSW92279), *McKee* 877 (MEL2174165), *Olde* 99/174 (CANB, MEL, NSW) and *Rupp* (NSW92281), are clearly assignable to subsp. *laurifolia*. Pistil length on these specimens ranged from 12–13.5(–14.5) mm long. The only specimen with an accurate location (*Olde* 99/174) was actually collected slightly to the east of Wentworth Falls. However, six specimens, *Burgess* (CANB4977), *Maiden s.n.* (P3354188), *Maiden & Cambage* (NSW92280), *Olde* 14/10 (NSW), *Olde* 14/11 (NSW) and *Shiress s.n.* (NSW92282), also from Wentworth Falls, are clearly assignable to subsp. *caleyana*, based on pistil length (18–19 mm). Two living populations examined in 2014, from south and north of Wentworth Falls but within the town

precinct, were both assigned to subsp. *caleyana*, the former showing a greater tendency to intergradation with subsp. *laurifolia* than the latter on leaf characters. Although taxa assignable to both subspecies were collected from the Wentworth Falls area, no evidence of co-mingling was adduced. Populations sampled were internally stable.

There is a categorical distinction in pistil length between the subspecies which is conceivably controlled by one gene with two alleles. This distinction, however, is not completely predictive of leaf-blade length:width ratios, although a very narrow gap was also detected between the taxa on this character. Ratios on some specimens of subsp. *caleyana* in the Wentworth Falls area and its near vicinity showed a strong approach to those of subsp. *laurifolia*. Leaf-blade length to width ratios were based on ten leaves per specimen when present or all leaves when less than 10. A simple ratio of the widest leaf to its length on any specimen was not reliably diagnostic. Ratios of 71 specimens with a distribution west of Wentworth Falls (subsp. *caleyana*) ranged between 1.31–2.19 (average length to width ratio = 1.64; standard deviation = 0.29). Ratios on sixteen specimens east of Wentworth Falls (subsp. *laurifolia*) ranged from 2.31–3.48 (average length to width ratio = 2.75; standard deviation = 0.36). Therefore, the leaf-blade length to width ratios readily distinguishes these two subspecies. However, seven measured specimens excluded from these ratios collected at Wentworth Falls ranged from 1.85–2.62 (average length to width ratio = 2.30; standard deviation = 0.87). The specimens collected at Wentworth Falls and its immediate vicinity are thus seen as the main contributors to the morphological intergradation. Two specimens, from areas of known hybridisation with *G. acanthifolia* (e.g. NSW4984, NSW92263) were eliminated.

Leaf characters are thus subordinate to pistil length. The fact that leaf characters (and some conflorescence characters) of one subspecies in a particular geographic area strongly approach those of the other suggests the likelihood of morphological intergradation deriving either from introgression between inter-fertile populations or phenotypic plasticity resulting from environmental pressures driving the evolution of separate taxa. In either case, all characters become relevant to the identification of intermediate individuals and their assignment to the recognised subspecies.

Morphological discontinuity generally warrants recognition at species rank, and this was considered here, based on pistil length. However, the clinal nature of the total morphological variation together with the degree of intergradation and overlap in a narrow geographic zone suggested that the populations represented by the two taxa were conspecific and sharing alleles. This informed recognition here of the metapopulations at subspecific rank.

The evolutionary forces that drive variation in *G. laurifolia* have not been identified. Leaf morphology is not strongly correlated with altitude. Specimens with the longest leaves occur between 300–875 m in the east but those with the shortest leaves between 500–1000 m. However altitude may play a part in pistil length. Specimens with the shortest pistils (9.5 mm) were located at the far east of the distribution in the Valley Heights–Warrimoo area at the lowest elevation *c.* 300 m. Specimens with the longest pistils (25–28 mm) were collected around Katoomba and Mt Victoria at around 1000 m, the highest elevation. Both subspecies inhabit the lower altitudinal ranges of their respective sides of the Dividing Range, down to *c.* 500 m on the western side. According to National Parks and Wildlife et al. (1998, p. 118) ‘the escarpment from Kings Tableland, through Wentworth Falls, Leura and Katoomba to Narrowneck Peninsula, contains ‘the highest concentration of endemic and rare or threatened taxa’ in the upper Blue Mountains. Evolutionary responses to uncertain environmental pressures are demonstrably apparent in the area and phenetic variation may also be attributable to them. A broad range of possibilities including pollinator preferences, exposure, temperature, rainfall and others not identified requires further study.

## Taxonomy

*Grevillea laurifolia* Sieber ex Spreng., *Systema Vegetabilium* 1827 Curae . Posteriores, 46.

**Protologue:** Ad Grevilleam R.Br.

Post n. 1. *laurifolia* Sieb. 38. Gr. foliis oblongis acuminatis venosis subtus strigillosis, racemis multifloris spicatus, germinibus villosis.

**Type:** ‘Nov. Holl.’

**Lectotype:** (*fide* R.O. Makinson 2000, p. 493): [New South Wales]: Blue Mountains, N. Holl., *F.W. Sieber*, ‘Fl. Novae Holl. No. 26’ [Printed label] K799224 - specimen at right (Kew Neg. No. 2179).

**Isolectotypes:** ‘Blue Mountains’ A35402; ‘Grevillea laurifolia Sibe Nov Hollandia Sieber 26’ B10\_0279562 - whole sheet; ‘Fl. Novae Holl. No 26’ BM915603- specimen at left of sheet; BR13460228; BRNM fasc. 6, 4.1, 142/1117 (*n.v.*); G389255; G389256; G389420; ‘Fl. Novae Holl. 26’ G-DC327547- specimen at top right of sheet 3; GOET (*n.v.*); H1327341; H1327342; ‘Fl. Novae Holl. No. 26’ Sieber n. H. n. 26 Grevillea laurifolia e nova Hollandia Sieber’ HAL110459; ‘Blue Mounts N. Holl. Sieber’ K799223 - specimen at left of sheet; KL (*n.v.*); L39475; ‘Grevillea laurifolia Sibr Sieb. Fl. nov. Holl. n.26’ [J.G. Agardh script] LD1047733; ?LE (*n.v.*); ‘Fl. Novae Holl. No. 26’ MEL47241 ex Hb. Sonder- whole sheet; ‘Grevillea laurifolia Sieber NovHolland’ ‘Fl. Novae Holl. No. 26’ MEL47243 ex Hb. Sonder; ‘Fl. Novae Holl. 26’ NY284635 acc. 1835; ‘Fl. Novae Holl. 26’ P2372439 ex Hb. Univ. Cath. Paris; ‘Grevillea laurifolia *Sieber* N. Hollandia Hrbr *Sieber* nr. 26’ ‘Fl. Novae Holl. No. 26’ P750717 ex Hb. Steudel ex Hb. E. Drake; ‘Fl. Novae Holl. No. 26’ Grevillea laurifolia Sbr Fl: Nov. Holland: n: 26’ P750718 ex Herb Ad. Brogniart 1863; ‘Fl. Nov. Hollandiae Sieber No. 26’ PERTH1575899; ‘Fl. Novae Holl. No. 26’ *Sieber* S07–11437; ‘N.H. S.B.’ S07–11438; TO (*n.v.*); TUB (*n.v.*); WRS� (*n.v.*).

**Description:** *Shrub* prostrate, trailing, sometimes forming mats to 6 m across, stenobasic or multi-stemmed, ornithophilous, facultatively xenogamous, probably also geitonogamous, sometimes killed by fire, regeneration from seed or lignotuber. *Branchlets* elongate, sometimes distichous, often secund, subterete or slightly angular, faintly ribbed from decurrent leaf bases, ferrugineo-sericeous, the hairs ultimately evanescent. *Leaves* (1.8–)3–15(–17) cm long, (0.8–)1.5–6.2(–7) cm wide, alternate, well-spaced, lateral to the ground or suberect, smaller leaves frequently proximal to larger leaves, spreading to ascending, sometimes patent, petiolate, simple, ovate or narrowly so to almost round or elliptic, narrow-elliptic, oblong-elliptic or oblong; petioles (3–)6–28 mm long, usually strongly recurved, sometimes erect, angular, channelled on the adaxial surface, densely sericeous; leaf apex usually obtuse, sometimes acute, rarely emarginate, mucronate or not, the mucro non-pungent, short, recurved; leaf base equal or unequal, cuneate or broadly so, occasionally attenuate, sometimes truncate; leaf margins crenate, often undulate, flat to shortly recurved with a prominent edgevein; adaxial surface glabrous or with scattered appressed biramous hairs, smooth, faintly rugose, subbrochidodromous, the midvein, lateral veins and sinuous intramarginal vein prominent, granulate, tertiary reticulum evident, the lateral veins prominent, ascending at 40°–70° to the mid vein depending on leaf width, usually but not always terminating in a looped intramarginal vein, sometimes terminating in the adjacent lateral vein, reticulum also evident between the intramarginal vein and the edgevein, the midvein sometimes sprinkled with appressed hairs; abaxial surface densely white- or ferrugineo-sericeous, the hairs sometimes partly evanescent with age; midvein and lateral veins prominent, the midvein sometimes glabrous, the lateral veins covered with hairs when present. *Conflorescences* 2–4(–8) cm long, erect, simple to 3-branched, terminal, subterminal or axillary, usually leaf opposed, secund to hemispherical, acropetal, 16–40-flowered; buds 7–10 mm long, 4 mm wide, ellipsoid to ovoid-cylindrical, imbricate, conspicuous, spreading, pedunculate; peduncles (3.5–)5–25 mm long, 0.7–1.5 mm thick, usually decurved, sometimes erect, brown-sericeous or sparsely so; floral rachises (9.5–)12–45 mm long, 0.7 mm wide, usually flexuous, angular, ribbed, densely red-sericeous, terminated by a subulate or truncate flowerless extension 1.5–5.0 mm long, the extension sometimes refracted, the nodes not raised, lateral, the floral scars oblong; peduncular bract 3–5 mm long, ovate-acuminate, solitary, distant; involucral bract 2.2 mm long, 1.5 mm wide, solitary; common bracts 1.5–2.5 mm long, 1.5–2.9 mm wide, broadly ovate, sometimes subspathulate, spreading or appressed, the tip often recurved to revolute, the abaxial surface densely ferrugineo-sericeous, flat to broadly convex, the adaxial surface glabrous, caducous before or sometimes persistent beyond anthesis. *Flowers* acroscopic; pedicels 2–4 mm long, sericeous; torus *c.* 1.5 mm across, transverse to slightly oblique; nectary semi-annular, erect, the margin flexuous, entire, thin; *pistil* 9.5–25(–28) mm long; gynophore (0.75–)1.3–4 mm long, densely sericeous to subsericeous with relatively long, white with intermixed red hairs; ovary *c.* 1 mm long, subvillous with hairs long, red and white, strongly ascending to appressed; style glabrous, exerted through the dorsal suture before anthesis, refracted above the ovary, either with persistent angular coursing and hooked apex or becoming smoothly looped and lacking a persistent hooked apex; style end smoothly but suddenly dilated, tightly enclosed in the limb before anthesis; pollen-presenter 1.0–1.4 mm long, 0.8–0.9 mm wide, oblique at (20°–)45°–60°(–70°), oblong-elliptic to almost round, convex; stigma prominent, ascending, central to distally off-centre; *perianth* 5–9 mm long, 1.8–2.5 mm wide, zygomorphic, ovoid-sigmoid, red-sericeous on the abaxial surface, glabrous on the adaxial surface, coherent except the dorsal suture separating ontogenetically up to the base of the limb before anthesis; perianth limb declined to declined-revolute, globular, red-brown-sericeous, symmetrical; pollen yellow to amber. *Fruit* 9–13 mm long, 4.5–5 mm wide, oblique on and usually inferior to a strongly curved stipe with attachment dorsal, dispermous or sometimes monospermous by abortion, slightly compressed, ellipsoidal, tomentose to tomentose-villous with red-brown stripes or blotches; pericarp *c.* 0.3 mm thick. *Seed* *fide* Blombery and Maloney (1992, p. 64), Olde and Marriott (1995, p. 228) 10–12 mm long, 3–4.2 mm wide, compressed-ellipsoidal, very narrowly winged all round or with a waxy border, the wing drawn out obliquely at each end and with a conspicuous eliasome at the apex; outer face convex, rugose, glabrous; inner face flat, rugose, glabrous; margin shortly recurved.

**Summary:** Important distinguishing features of *Grevillea laurifolia* are its prostrate trailing habit, its leaves conspicuously petiolate, round to ovate, elliptic to oblong, the margin irregularly crenate, often undulate, shortly recurved or flat, the base cuneate to truncate, unequal or equal, the abaxial surface exposed, sericeous, the hairs sometimes evanescent, the venation brochidodromous or almost so, prominent on both surfaces, the texture markedly coriaceous; confluences secund to hemispherical, mostly terminal or subterminal, leaf-opposed, simple or few-branched, pedunculate; buds shortly cylindrical to narrow-ovoid, conspicuously bracteate; rachises ribbed, usually flexuous, with a short flowerless extension, a remote peduncular bract usually evident; torus transverse to slightly oblique, cupuliform; nectary prominent, erect, U-shaped; pedicels 1.5–3(–4) mm long, concolorous; perianth zygomorphic, slightly sigmoid, the abaxial surface densely sericeous, the adaxial surface glabrous; perianth limb symmetrical, obtuse, lightly ferruginous; hairs around or behind the anthers absent; ovary stipitate; the gynophore densely white-subvillous with reddish hairs intermixed, erect during floral ontogeny but often strongly incurved and superior on the dorsal side of fruits; style glabrous, exerted from the dorsal perianth suture; style-end abruptly expanded, green to yellow-green; pollen-presenter oblique, broadly convex, green; fruit compressed, ellipsoid, sometimes monospermous, the abaxial surface ecostate, densely white-tomentose with reddish-stripes and blotches; seed compressed-ellipsoid, marginate with short oblique terminal elaiosome.

**Discussion:** The species in Group 35 *sensu* Olde and Marriott to which *Grevillea laurifolia* appears most closely related are all eastern species and all have divided leaves, including *G. macleayana* (McGill.) Olde & Marriott, which has mostly simple leaves but sometimes also has lobed leaves. Within that group *G. laurifolia* is the only species with simple, entire leaves, although it does have crenulate margins. While these crenulations might be interpreted as a form of division, evidence in other genera (e.g. *Eucalyptus* which never has divided leaves) and the lack of evident or suppressed venation to the terminal, suggests otherwise. Environmental pressures associated with the evolutionary change from lobed to entire adult leaves with crenulate margins are unclear as *G. laurifolia* frequently co-occurs with its putatively closest relative, *G. acanthifolia*, which has deeply lacinate, glabrous leaves with at least two orders of division.

### Key to subspecies of *Grevillea laurifolia*

- 1 Leaves with an average blade length to width ratio  $>2.2$ : 1; longest petioles (12–)15–28 mm long; leaves mostly elliptic to oblong-elliptic or narrowly ovate-acuminate with base attenuate or not; longest leaves (6–)8.5–17 cm long; confluences dense, broadly secund to hemispherical (semicylindrical); floral rachises 12–32(–45) mm long; perianth 5.5–6 mm long, the adaxial surface maroon to black-red; pistils 9.5–14(–14.5) mm long; style after anthesis angularly infracted ..... subsp. *laurifolia*
- 1\*Leaves with an average blade length to width ratio  $<2.2$ : 1; longest petioles  $< 16$  mm long; leaves mostly broad-elliptic, ovate or round, occasionally elliptic, rarely oblong-elliptic with truncate to broadly cuneate base; longest leaves 5.5–11.5 cm long; confluences moderately dense to open, secund; floral rachises (20–)25–50 mm long; perianth (6–)7–9 mm long, the adaxial surface red; pistils 17–25 mm long; style after anthesis arcuately incurved ..... subsp. *caleyana*



**Fig. 1.** *Grevillea laurifolia* subsp. *laurifolia* Springwood, Blue Mountains. Photo P.M. Olde (Jun 2014)

*Grevillea laurifolia* Sieber ex Spreng. *subsp. laurifolia*

*Grevillea amplifolia* Gandoger (1919, p. 231)

**Protologue:** Grex *G. laurifoliae* Sieber. Spica patula, densa, ferruginea, folia 2.5–3.5 cm lata. Folia oblonga, basi attenuata.

**Type:** Australia, ad Blue Mountains [New South Wales] (*Baker n. 2404! Maiden!*)

**Lectotype:** *fide* D.J. McGillivray (1973, p. 340): [New South Wales] ‘G. 2404 *Grevillea laurifolia* Sieb. Proteaceae, Blue Mountains, W.B. (*W. Bäuerlen*) Aug 1899’ (LY –Hb. Gandoger, comm. R.T. Baker Technological Museum Sydney).

**Isolectotypes:** ‘No 2404 *Grevillea laurifolia* August 1899 Valley Heights, Blue Mountains, *W. Bäuerlen* [*W. Bäuerlen script*] MEL; NSW544178 – flowers.

**Possible isolectotypes:** ‘*Bäuerlen s.n.* July 1899’ ?B (*n.v.*); CANB (not found); K; MEL (not distributed); NSW544175; NSW544177; NSW974488; NSW974493; ‘Blue Mountains, Jul 99’ [*Maiden script*] NY02281147; ?US (not found) – flowers.

**Residual syntype:** ‘Blue Mountains, Australia’ *J.H. Maiden s.n.*, Oct 1898 [*Maiden script in part, Gandoger script in part*] LY.

**Possible residual syntypes:** ‘Leura’ *Anon.*[? *J.H. Maiden*], 10.98’ P02370403 ex NSW; ‘Burraborang to Wentworth Falls’ *J.H. Maiden s.n.*, Oct 1898 (NSW92290, NSW841872).

**Discussion:** Although Gandoger attributed R.T. Baker as collector of the lectotype, it is clear from the specimen label itself at LY that the collector was W.B. [*W. Bäuerlen*] and that the specimen was sent to Gandoger by R.T. Baker. The specimen at NY was also remitted by Baker. The morphologically indistinguishable specimens collected by *Bäuerlen* in July have been treated here as possible isolectotypes on the basis that they may be part of the same collection event but incorrectly dated.

*Grevillea laurifolia* ‘smaller-flowered form’ *sensu* McGillivray and Makinson (1993, p. 58)

**Description:** Leaves (5.5–)6–15(–17) cm long, (0.8–)1.6–5.2 cm wide, narrowly ovate-acuminate to oblong or oblong-elliptic, occasionally broadly elliptic; longest leaf blades 6.5–14.2 cm long, the abaxial surface frequently with a sparse indumentum or densely sericeous; ratio of the longest leaf to the widest leaf per specimen 1.8–3.7(–6.1): 1; overall leaf blade length to width ratio 2.2–3.5:1; leaf base attenuate to cuneate, sometimes truncate; petioles (8–)15–28 mm long; *unit conflorescences* broadly secund to hemispherical, dense; floral rachises 12–30(–45) mm long; rachis extension 1.75–5 mm long; common bracts 1.75–2.5 mm long, 1.5–2.5 mm wide; peduncular bracts 3–6 mm long; peduncles 3.5–18 mm long; 16–30(–34)-flowered; *flower* with perianth maroon red outside, maroon to blackish red inside, the beard white, limb maroon-red; style pinkish-red or dark red with green to yellow-green style-end and pollen-presenter; *pedicels* 2–3(–3.5) mm long; perianth 5–6 mm long, 1–1.8 mm wide; pistils 9.5–14(–14.5) mm long; gynophore (0.75–)1.0–2.0 mm long; style angularly twice refracted, infracted just above the ovary, hooked 1–2 mm below the apex; pollen-presenter oblique at 20°–60°.

**Chromosome number:**  $n = 10$  *fide* Ramsay (1963, p. 11).

**Distribution:** New South Wales, between Valley Heights and Wentworth Falls at elevations of 250–835 m.

**Phenology:** Specimen data record flowers from every month of the year but, from personal observation, winter–spring appears to be the main flowering flush with occasional flowers outside these times. Episodic flowering in response to a drought-breaking storm might also account for some out-of-season flowers. Fruits were observed forming in November 2014 on a population at Springwood.

**Habitat:** Grows in open Eucalypt forest, mostly on dry stony ridges, trailing over sandstone outcrops or embankments in sandstone-derived, shallow sandy soils, often with numerous loose stones. It is generally associated with xerophytic species tolerant of dry, hot conditions.

**Conservation status:** There appears to be no immediate conservation imperative with respect to *G. laurifolia* subsp. *laurifolia*. However, this taxon is strongly impacted by residential development and needs a full assessment.

**Variation:** In the lower Blue Mountains, between Warrimoo and Woodford, pistil length for *G. laurifolia* subsp. *laurifolia* ranges from 9.5–12 mm long. Some specimens at Wentworth Falls have pistils 13–14(–14.5) mm long. A specimen with variegated leaves from Wentworth Falls collected by *M. Thompson s.n.* (NSW409029) appears, from the leaves in the photograph attached to the specimen, to belong with this subspecies. The specimen itself is in young bud.

The infertile specimen collected by *I. Bowden s.n.* (NSW4984) from Woodford, within the distribution of *G. laurifolia* subsp. *laurifolia*, has leaves with a leaf blade length to breadth ratio of 1.67, a ratio normally associated with *G. laurifolia* subsp. *caleyana*. The collecting notes indicate that it was growing ‘in association with *G. acanthifolia* and the probable hybrid *G. x gaudichaudii*’. This plant is apparently also sharing genes with *G. acanthifolia* as the distal leaf on the NSW specimen appears lobed. It is here excluded from the circumscription of *G. laurifolia*. This is the only record of hybridisation involving *G. laurifolia* subsp. *laurifolia* and *G. acanthifolia*, which, at Woodford, is the most easterly record of the latter’s distribution.

**Selected specimens** (27 examined): New South Wales: Valley Heights, *W. Bäuerlen* 2404, Aug 1899 (B (*n.v.*), CANB, K (*n.v.*), MEL, NSW544177, NSW974493, NY, US (*n.v.*)); Springwood, [*W. Bäuerlen*], Sep 1899 (NSW544176); Linden Ridge, *D. Benson 1553 & D. Keith*, 11 Nov 1983 (NSW544174); Nelson Avenue, Wentworth Falls, *W. Blakely s.n.*, Oct 1938 (NSW92283); Martin’s Park, Farm Road., Springwood, *R. F. Brown 1035*, 10 Aug 1986 (NSW); Woodford, *R.H. Cambage 4010*, 6 Dec 1913 (NSW92287); Oxley’s First Expedition, *A. Cunningham s.n.* 1817 (NSW106086); ?20 miles [35 km] on the Blue Mountains, ‘*G. laurifolia* seen Blue Mtns’ *A. Cunningham 30*, without date (K- specimen at right); Wentworth Falls, *H. Deane s.n.*, Nov 1888 (NSW92279); Eastern range of the Blue Mountains, *C. Fraser s.n.*, without date (A ex BM); N. Hollande, Port Jackson, *C. Gaudichaud s.n.*, Dec 1819 (P02370407); Lawson, *A.A. Hamilton s.n.*, 15 Oct 1898 (NSW92285); Springwood, *R. W. Johnston s.n.*, 1 Oct 1948 (P03346533); Warrimoo, *R. Johnstone 2650 & A. Orme*, 8 Nov 2009 (AD255373, BRI, CANB723217, K, MEL2357608, NE, NSW799287, NSW883262); Wentworth Falls, *H.S. McKee 877*, 6 Dec 1953 (MEL2174165); Woodford, *J. Maiden s.n.*, 1899 (MEL, NSW92286); Sassafras Gully, Springwood, *P.M. Olde 93/23*, 14 Aug 1993 (NSW972912); Lawson, *c.* 1 km S of Blue Mountain trig, *P.M. Olde 99/173*, 5 Nov 1999 (CANB571236, NSW534908); Tableland Road., *c.* 1 km from Queen Victoria Memorial Hospital towards Highway, Wentworth Falls, *P.M. Olde 99/174*, 5 Nov 1999 (CANB571397, MEL2203845, NSW534907); Track to Martin’s Lookout, off Farm Road., S of Springwood. 33°43’S 150°34’E, *P. M. Olde 2000/01 & A. Graham*, 30 Jan 2000 (NSW534923 – flowers); 8 km from Faulconbridge, *J. Pulley 858*, 28 Sep 1971 (CBG42561); Blue Mountains, *W. Woolls s.n.*, ? Feb 1870 (MEL2174154).



**Fig. 2.** *Grevillea laurifolia* subsp. *caleyana*. Near Hartley, N.S.W. Photo P.M. Olde October 2014

*Grevillea laurifolia* subsp. *caleyana* P.M. Olde, **subsp. nov.**

Affinis subspecie *laurifoliae* sed foliis plerumque brevioribus latioribusque, 2–8.5(–12) cm longis, 2–4.6(–7) cm latis, vel ovatis vel ellipticis vel rotundis, conflorescentiis forte secundis, floribus minus confertis, pistillis longioribus (> 15 mm longis), stylis arcuatis, floribus rubicundis differt.

**Type:** New South Wales. Eastern side of Mt Banks, on Explorers Range Track, Blue Mountains National Park, 33°35'22"S 150°22'37"E, *W.A. Cherry s.n.*, *R.G. Coveny*, *P.D. Hind & D.G. Williams*, 15 Dec 2004 (holo: NSW763209; iso: AD, BM, CANB, G, NSW794548, MEL, NY, PERTH (distribuendi).

?*Grevillea cordigera* Gandoger (1919, p. 231)

**Protologue:** Ad *G. parvifloram* R. Br. accedunt.....Folia ovata, basi cordata.

**Type:** Australia, N.S.Wales, *Walter!* (holo: LY).



**Description:** *Leaves* (1.8–)2–8.5(–11.5) cm long, 2–6.2(–7) cm wide, ovate to ovate-elliptic, subcircular to broadly elliptic; longest leaf blades 3.5–9.8 cm long, densely sericeous on the abaxial surface; ratio of the longest leaf to the widest leaf per specimen 1.38–2.6: 1; overall leaf blade length to width ratio 1.2–2.1: 1; leaf base broadly cuneate to truncate, occasionally attenuate; petioles (3–)5–15 mm long; *unit conflorescence* secund, moderately dense; floral rachises (10–)25–45(–50) mm long; rachis extension 1–5 mm long; common bracts 1.5–3 mm long, 2–3 mm wide; peduncular bracts 2–5.5 mm long; peduncles 5–25 mm long; 14–40-flowered; *flower* with perianth red outside, purplish-red inside on the dorsal tepals at the curve, the exposed beard white; limb dull yellow; style bright red with green to yellow-green style-end and pollen-presenter; *pedicels* (2–)3–4 mm long; perianth (6–)7–9 mm long, 2–3 mm wide; colour of adaxial surface of perianth red; pistils (15–)17–25 mm long; gynophore 2–3(–4) mm long; style initially angular soon smoothly incurved to suberect; pollen-presenter oblique at 20°–70°.

**Distribution:** New South Wales mainly in the upper Blue Mountains and on the slopes of the Great Dividing Range, between Wentworth Falls and Lithgow, south to around Mt. Werong and east from Wombeyan Caves towards Mittagong. Elevation ranges from c. 500 m to 1000 m. Specimens from beyond Colong and Mt. Werong were first recorded by Cambage (1911, pp. 581 and 582).

**Phenology:** Flowers have been recorded from specimens between (March–) June–January but the main flowering period is from November–January, generally much later than for *G. laurifolia* subsp. *laurifolia*.

**Habitat:** Grows in sclerophyll forest, often in the interzone between dry sclerophyll forest and heathy swamp. In the latter habitat, it frequently co-occurs with *Grevillea acanthifolia*, with which it is known to hybridise in disturbed conditions. In these situations, *G. laurifolia* occupies the drier, better-drained margins. It also occurs in well-drained sandstone-or granite-derived sandy soils either in low scrub under a canopy of Eucalypts or in more exposed situations under scattered taller plants that include *Banksia*, mallee *Eucalypt*, *Casuarina*. Although populations at higher elevations are often found near moist depressions or around the margins of perched swamps, it is generally tolerant of a wider range of conditions than its congener, *G. acanthifolia* and they do not always co-occur. *Grevillea laurifolia* subsp. *caleyana* is mostly found at altitudes in excess of 800 m. However, habitat altitude at around 500 m in the Wombeyan Caves area suggests that elevation alone is not driving evolution in this species.

*Grevillea laurifolia* subsp. *caleyana* is the taxon commonly cultivated for its larger flowers.

**Conservation Status:** Not presently endangered as it is well conserved in a number of National Parks and Conservation Reserves.

**Etymology:** From the latinised surname *Caleyus* - in honour of George Caley (1770–1829) and the Latin suffix '-ana'. The epithet selected aims to acknowledge Caley's epic journey, his recognition of the plant's distinctness for which he supplied the provisional epithet 'procumbens', his leadership and his ability and willingness to make botanical collections on such a difficult journey.

**Variation:** A specimen with variegated leaves has been collected at Newnes Plateau by G. D'Aubert 732 & K. Marriott (NSW227741). The specimen is infertile but is deemed, from its leaves and distribution, to belong with subsp. *caleyana*.

**Discussion:** *Grevillea laurifolia* subsp. *caleyana* is part of a morphologically distinctive, widespread population, parapatric with respect to *G. laurifolia* subsp. *laurifolia*, that was sampled by George Caley at Mount Banks in 1804. Apart from distribution, the strongest characters in its recognition are its pistils > 15 mm long and a leaf blade length to width ratio  $\leq 2.2:1$ . An opportunity for belated botanical recognition of Caley's discovery is thereby afforded in recognition of the new subspecies. Caley's extant specimens (BM915603, NSW113814, PERTH2440202) are diagnostically compromised. An image of Caley's collection from Mt Banks can be viewed online by searching *Grevillea laurifolia* at <http://plantnet.rbgsyd.nsw.gov.au>, where there is also a distribution map for the whole species. Better specimens recently collected from the Mount Banks area are clearly part of the undescribed taxon here recognised as *G. laurifolia* subsp. *caleyana*.

Apart from the morphological and ecological features cited in support of its recognition, the capacity to resprout from lignotuber in at least one population at Clarence, observed in October 2014 by the author following wildfires in the Blue Mountains in 2013, might also be more widespread and further observations of fire response in all populations is recommended. Musson and Fletcher (1927, p. 127) also recorded that 'in very old plants the basal thickening forms a large knob and the stems arising from it may be an inch in diameter or more for some feet from the base'.

**Specimens Seen** (73 examined): Australia: New South Wales: Central Tablelands: Leura, *R.T. Baker s.n.*, 20 Jan 1911 (NSW544180); 3 km from Great Western Highway towards Mt. Victoria Lookout, *P. Beesley 224*, *S. Donaldson & P. Ollerenshaw*, 22 Nov 1984 (CBG8411611, NSW544193); Loombah Plateau, 41 km west of Yerranderie, *D. Benson 2440 & D. Keith*, 20 Nov 1985 (NSW544182); Clarence – Mt Victoria, *J. Boorman*, Jan 1914 (NSW92263); Blackheath Creek, Hartley, *R.F. Brown 2352*, 12 Sep 1994 (NSW); Wentworth Falls, *C. Burgess s.n.*, 9 Dec 1961 (CANB4977); Bell, *C. Burgess s.n.*, 26 Mar 1968 (CBG22797); Shipley, Blackheath *C. Burgess s.n.*, 9 Nov 1959 (CANB10461, NSW544196); ‘Near Mt. Banks [33°35’S 150°22’E], trails on the ground or procumbent’ *G. Caley s.n.*, Nov. 1804 (BM915603 – specimen at right of sheet; NSW113814; PERTH2440202); Katoomba, *W.M. Carne s.n.*, Jan 1922 (NSW544199); Newnes Junction–Newnes 12 miles [19 km] *E. Cheel 332*, Nov 1901 (A); Mittagong to Wombeyan Caves, *E. Cheel s.n.*, Dec 1912 (NSW92291); Blackheath, *E. Constable s.n.*, 17 Nov 1946 (NSW3532); Medlow Bath, *R. Coveny 11366*, 17 Nov 1982 (A, B, CANB348553, COLO, K, L, LE, MO, NBG, NSW544192, PE, PERTH1820125, PRE, RSA, W); Mount Boyce, 1.9 km NNW of Blackheath, *R. Coveny 4752 & J. Armstrong*, 4 Dec 1972 (A, DNA44548, NSW544189); Range Fire Trail, c. 1.7 km north of Chalkers Pinch, c. 29 km directly north-east of Taralga, *I. Crawford 4680*, 2 Jun 1998 (CANB612668, NSW466942); Mt Wilson, *P. Croucher s.n.*, 8 Sep 1960 (CBG20252); Sandy parts of the Blue Mountains and near Cox’s River, *A. Cunningham 36*, without date (K799222 – Kew Neg. No. 2180); *Grevillea laurifolia* Br (humifusa [6 Sep] 1817 AC) B. Mountns, *A. Cunningham [?30]*, 1817 (K – specimen with label at left); 7.5 km along Haystack Ridge, off Bells Line of Road, 33°32’S 150°23’E, *A. Curry 8616*, 17 Jun 1986 (NSW240758); Newnes State Forest, *G. D’Aubert 732 & K. Marriott*, 15 May 1990 (NSW227741); Georgiana, Head of Abercrombie River, *P.R. Daniel*, Sep 1954 (NSW92293); Esk Bank, *A.A. Hamilton s.n.*, Nov 1914 (NSW92260); Megalong Creek, Megalong Valley, *L.A.S. Johnson s.n.*, 1 Oct 1945 (NSW92274); Bindook Swamp, 7 miles SW of Yerranderie, *L.A.S. Johnson 1072 & B.G. Briggs*, 29 Nov 1966 (NSW96437); Broughton’s Lookout, beside road to Wombeyan Caves from Taralga, *K. MacDougall 882*, 7 Nov 2000 (MEL2210914); Pierce’s Pass Track, 200 m from Bilpin-Bell road, *D.J. McGillivray 3738*, 31 Oct 1976 (K, NSW544190, US); Wentworth Falls, *J.H. Maiden & R.H. Cambage s.n.*, 14 Nov 1904 (CANB3090; NSW92280); Richlands-Wombeyan Caves Road, 5.4 km E of Wiaborough turnoff, W of Broughton’s Lookout, *R.O. Makinson 108*, *R. Coveny & W. Bishop*, 18 Sep 1985 (NSW544195); Batsch Camp near Mt Werong, *V. Murtagh s.n.*, 5 Nov 1973 (NSW544183); Hyde Park Reserve, Little Hartley, *P.M. Olde 14/07*, 6 Oct 2014 (NSW); Southern end of Sport Reserve, Langford St., Wentworth Falls, *P.M. Olde 14/10*, 27 Oct 2014 (NSW); Blaxland Road., corner of Beatty Street, Wentworth Falls, *P.M. Olde 14/11*, 27 Oct 2014; c. 4 km along Marrangaroo Creek firetrail, NE of Marrangaroo Army Depot, Lithgow, *A.E. Orme 400*, *R. Johnstone*, & *C. Whitton*, 25 Oct 2003 (CANB583036, NSW616999); Ridge to Mt. Haystack, c. 3 km west of Mt. Tomah, *J. Pickard 1228*, 24 Oct 1970 (NSW544185); Swamp on Mt. Cameron track c. 1 m W of Dinner Creek, 12 km N of Bell, *J. Pickard 730 & D. Black*, 16 Nov 1969 (NSW88629).

### Acknowledgments

Thanks to the directors of A, CANB, G, LY, MEL, NSW, NY and PERTH for access to their specimens. Travel to LY in 2003 was facilitated by a grant from the Sutherland Group of the *Australian Plants Society*. Online digitisation has greatly assisted typification through websites maintained by some individual herbaria, especially K, NY, P as well as those provided through JSTOR. Access to specimens (not yet lodged) recently donated to NSW by Mr Ray F. Brown was also particularly helpful. While serving as *Australian Botanical Liaison Officer* at Kew in 2009, Dr Tony Orchard (then ABRS) traced then undiscovered isoelectotypes and Dr Anton Igersheim (W) provided critical information on Sieber and his collections, especially the presence of isoelectotypes in herbaria not visited by the author. Discussions with Andrew Orme (NSW) and Wayne Cherry (NSW) were also much appreciated. An earlier version of this manuscript reviewed by Dr. Marco Duretto (NSW) was much improved by his suggestions as was the version reviewed by two anonymous referees.

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Manuscript received 11 December 2014, accepted 10 March 2015